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Thomas Condon

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Supplement to Vol. III. No. 3

DEPARTMENT OF GEOLOGY

A NEW FOSSIL PINNIPED

(Desmatophoca Oregonensis)

FROM THE

MIOCENE OF THE OREGON COAST

BY

THOMAS CONDON



MAY, 1906

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Skull of *Desmatophoca oregonensis* Condon; side view; about one-third natural size. (Type.)



INTRODUCTION

Among the many problems connected with the divergence of the different lines of mammalian life, but few are of greater interest to the paleontologist than the origin and development of Pinnipeds.

That the Sea Lion, Fur Seal, Walrus and common Seal or Phoca are closely related to the dog, bear, tiger and the other terrestrial carnivora seems to be a fact too well established to be questioned.

But the study of the facts that give rise to this conclusion only deepens the mystery of the origin of Pinnipeds and suggests many perplexing questions for the solution of paleontologists.

First, did the departure of the marine carnivora from their terrestrial parent stock occur after the land carnivora had become distinctly characteristic orders? Or must we look for the first Pinnipeds before there were any true wolves or bears or tigers, so far back in time that all of these forms were still blended in the more ancient and generalized orders of mammalia. This hypothesis would give Pinnipeds a lineage as ancient as any of our land carnivora. Again were all pinnipedia derived from the same type of Carnivora, or does the Phoca represent one line of departure and the remaining members of the suborder, have a different origin?

Naturally the student of ancient life looks to fossil forms for the answer to these and many other perplexing problems. But unfortunately fossil Pinnipeds of all forms are extremely rare, especially of the family Otariidae to which the Sea Lion and Fur Seal belong. So far as we are aware, no fossil Otariidae have been certainly identified older than those found by Dr. Haast in the Moa Caves of New Zealand and these, being of Pleistocene age, are so similar to modern forms as to throw but little light upon the more remote past of the family. Under these circumstances it is not strange that much interest is centered around a fossil Pinniped found in the Miocene formation along the sea coast of Oregon. We feel no hesitation in assigning this fossil to the Miocene, for, owing to changes of level on our coast, Marine Pliocene deposits are very rare in Oregon. And in the vicinity of the fossil bed in question there are but two formations: first, the elevated beach of the Pleistocene, which with its capping of recent sand dunes stands nearly

one hundred feet above the level of the present beach; and second, there is a solid base of Miocene Sandstone which dips gently toward the sea. It was in this sandstone that the seal head was found and it is rich in such characteristic Miocene shells as *Arca*, *Nucula* and *Glycimeris*.

Further confirmation of the age of this sandstone may be found in a publication by Dr. Diller of the United States Geological Survey, 1896.* In speaking of this same region and formation Dr. Diller says: "It is here that the Miocene has its greatest development on the coast of Oregon and is well characterized by abundance of fossils." He then quotes Dr. Dall as having identified many Miocene shells from this formation, among which he mentions *Crepidula*, *Euthria*, *Purpura*, *Natica*, *Leda*, *Yoldia* and *Arca*.

There can therefore be no doubt that this is a Miocene Pinniped, and it should throw some important light upon the evolution of the order.

We wish here to acknowledge the kindly interest in this publication of the eminent Paleontologist, Dr. J. L. Wortman, to whom we are grateful for valuable assistance given to the venerable teacher of his earlier years.

DESCRIPTION

The skull is wonderfully seal like in general appearance; it is over a foot in length, slender and graceful in outline. The muzzle is broad and square, its breadth just back of the canines being three inches, or nearly one-fourth of the length of the skull exclusive of the occipital condyles. The square muzzle, with the large canines and outer incisors, give the front of the skull a strong resemblance to Steller's Sea Lion. The infraorbital foramen is large and situated beneath the fourth premolar with its upper border very close to the malar bone.

The premaxillae articulate with the nasals for a distance of about one inch, but lack one and one-half inches of extending backward far enough to meet the frontals. The nasal bones are long and slender, of nearly uniform width. Their posterior extremities are pointed and wedged in between the anterior ends of the frontals. In this feature our fossil agrees with *Phoca* and most land *Carnivora* and differs from *Otaria* where the frontals separate the nasals. The frontal bones where they are separated by the nasals do not terminate in sharp points, as is usual in the *Carnivora*, but leave the nasals with a sweeping curve

*A Geological Reconnoissance of North Western Oregon.

which with the wide angle of separation gives the frontals a cordate ending.

The postorbital processes are quite rudimentary, being limited to a very small knob an eighth of an inch in diameter, and there is no evidence that the processes have been broken or destroyed. In this *Desmatophoca* differs widely from *Otariidae* and agrees more nearly with *Phocidae*.

On neither side is the zygomatic arch complete, but from the study of both sides its form can be readily determined. The greatest breadth across both arches is seven and one-half inches, measured just in front of the brain case. It is somewhat flattened across the outer part of the curve and is notably of great depth and strength as compared with any of the modern Pinnipeds.

The malar is heavy and extends forward as far as the third premolar. Posteriorly it divides into two branches, a superior and inferior branch, between which the anterior extremity of the zygomatic process of the temporal is received. This arrangement is much like that of *Phoca* and somewhat different from that of *Otaria*.

The postorbital constriction is of unusual length. Between the rudimentary postorbital processes and the brain case there is almost two inches of slender ridge having a nearly uniform width of one and three-eighths inches. This narrow middle portion of the skull added to the long nasal bones gives the cranium a slender, graceful form quite characteristic of the specimen.

The sagittal crest is lacking, the ridge being smooth and bearing no marks of having been broken. The development of the occipital crest can not be determined with absolute certainty as that part of the brain case has been damaged, but it would seem to have been poorly developed as that portion of the occipital bone directly above the foramen magnum slopes forward at an angle of forty-five degrees, and there is reason to believe the general shape of the occipital or lambdoidal crest presented that characteristic U-shaped form of *Phoca* rather than that of *Otaria*.

The back part of the brain case has been broken away exposing a fine cast of the greater part of the cerebral lobes and showing their well marked convolutions. By referring to the list of measurements it will be seen that the length, breadth and height of the brain case are very nearly equal and indicate a well developed brain. The convolutions however, are plainly coarser and less complicated than in any of the modern Pinnipeds.

The occipital Condyles stand out from the base of the skull with decided prominence. The length, measured on their curved surface, is nearly two and one-half inches, while the decidedly convex surface of the breadth measures one and one-fourth inches.

The mastoid region is very different from that of any of the modern Pinnipedia. The mastoid process itself is not so large and rugose as that of a large male Sea Lion, but very much exceeds that of any of the Phocidae. The paroccipital process is unusually large and powerful, and projects backward and a little outward. It is widely separated from the mastoid in marked contrast with that of the Sea Lion, in which it is united with the mastoid. It differs again from that of Phoca in which the paroccipital is wanting. The matrix has not been removed from the base of the skull so that its description can not be given at this time.

DENTITION

The two outer incisors are large and canine like, the inch of space between them having been filled by four small front incisors. These four teeth are unfortunately lost, but their size and position can be easily determined by the alveolar cavities which are filled with the light grey sandstone matrix and can be readily distinguished from the harder and darker colored bony partitions between them.

The Canines are well developed, being one and five-eighths inches in length and seven-eighths of an inch in width at the alveolar border. They are slender rather than massive, and gracefully recurved below. The first of the molar series, or perhaps we may say the first premolar, is lost, but the alveolar cavity shows it to be single rooted and situated directly back of the canine without diastema.

The second premolar is present on both sides. It is a simple tooth with a pointed conical crown, the symmetry of its outline being broken by the suggestion of a posterior cusp. This tooth has two roots. The third of the molar series is absent on both sides, but we find from the alveolar cavities that like the second, it is double rooted.

The fourth premolar is present on both sides, its length is about half an inch and breadth about the same. On the left side of the upper jaw the crown is present, but the portion of the maxillary directly above the tooth has been broken away including the greater portion of the roots. Just enough root surface adheres to the crown to make it clear that this important fourth premolar corresponding to the sectorial tooth of most

land carnivores is in the possession of three distinct roots. That supporting the main cusp is separate and distinct, but the two devoted to the inner and posterior cusps are more or less fused at their base.

The crown of the fourth premolar exhibits some unusually interesting characters for a Pinniped.



Inside view of fourth upper premolar



Outside view of fourth upper premolar



Top view of fourth upper premolar

When viewed from above it is roughly triangular in cross section at the base. It is composed of a large slightly incurved and recurved main cusp, which corresponds with the antero external blade of the typical carnivorous sectorial. Behind this the remains of a posterior external cusp are very evident. The internal cusp while not forming a distinct tubercle, exists as a broad internal ledge. It is a matter of especial importance to note that the principal wear of this tooth took place in the position of the shear of the typical carnivore.

In fact in studying this tooth we have caught our Miocene Pinniped in the act of deserting the flesh tearing complex dentition of the land carnivora and of reverting back to the simple, conical, reptile-like teeth most favorable for the capture and holding of the elusive and slippery fish.

And yet this retrograde step in dentition does not seem to have been accompanied by any general degeneration, for our fossil had a well developed brain capacity, and modern Pinnipeds have an even finer brain structure and presumably a higher grade of intelligence, comparing most favorably with the highest of terrestrial carnivores.

The fifth of the molar series or the first true molar is lost, but its presence in life is well marked in the fossil by two nearly circular alveolar cavities, the posterior cavity being slightly larger than the anterior. They are filled with soft, light grey sandstone and bordered by brown bonny rings, thus giving positive evidence that the first molar had two roots, the posterior being the larger of the two. It is possible that this tooth had another inner root but the evidence is too obscure to mention. This first true molar is situated directly behind the fourth



Skull of *Desmatoploca oregonensis* Condon; top view; about one-third natural size. (Type.)

premolar without the diastema found in some modern Sea Lions. Unfortunately all information of the nature of the crown is lacking and there is no evidence of a second true molar.

MEASUREMENTS OF SKULL OF DESMATOPHOCA OREGONENSIS

	Inches
Length of skull exclusive of occipital condyles,	12 5-8
Greatest breadth of skull is just in front of the brain case across the zygomatic arches,	7 1-2
Least breadth across the ridge of skull,	1 1-8
Breadth of skull just back of canines,	3
Breadth of skull at the rudimentary post orbital processes,	1 3-8
Breadth of skull at mastoid processes,	6
Greatest width of anterior nares,	1 1-4
Height of upper border of anterior nares from palatal plain,	1 3-8
Horizontal distance from anterior border of premaxillaries to front edge of nasals,	1 3-4
Width of nasals at anterior extremity,	1 1-8
Length of nasals,	3
Horizontal distance from anterior border of premaxillaries to post orbital processes,	5
Distance between rudimentary post orbital processes and brain case,	2 3-8
Height of skull above palatal plain at post orbital processes,	3 1-2
Height of cerebral lobes above the extension of palatal plain,	3 3-4
Transverse width of brain case,	4 1-8
Anterior and posterior length of brain case from foramen magnum,	4 1-4
Breadth of occipital condyle measured on the curve,	1 1-4
Length of occipital condyle measured on the curve,	2 1-4
Distance of extremity of mastoid from brain case,	1 1-4
Distance of extremity of paroccipital from the brain case,	1 1-2
Distance between distal extremities of mastoid and paroccipital,	2
Length of canine,	1 5-8
Width of canine at alveolar border,	7-8
Length of two outer incisors,	1
Space between outer incisors,	1
Length of second premolar,	5-8

Width of second premolar,	4-8
Length of fourth premolar,	4-8
Width of fourth premolar,	4-8
Distance from anterior border of premaxillaries to posterior border of first true molar,	5
Distance from posterior line of canine to posterior border of first true molar,	3 1-2

LOWER JAW

There is in association with the above described cranium a portion of a lower jaw consisting of the greater portion of a horizontal ramus bearing what is presumably the entire dentition. The relative position of the two specimens within the formation and the exact circumstances of their discovery are not very certain, but there can be little doubt of their reference to the same species. The lower jaw is decidedly deep and heavy with an unusually powerful symphysis. In this respect it resembles Otaria and is very different from Phoca. The incisors are not present in the fossil and are indicated only by their alveoli which are two in number.

The canine is large and powerful; its crown is long, stout and considerably recurved. The first premolar is missing but its former presence is indicated by a single alveolus which follows immediately or only after a very slight interval behind the canine. The second premolar is a double rooted, conical tooth having besides the main lobe of the crown both an anterior and posterior basal cusp. The length of the crown and width of its base are about the same measuring a little over half an inch. The remaining premolars and single molar are represented by roots only. Of these the third and fourth premolars were somewhat larger than the second, while the first molar was smaller. The jaw is broken immediately behind the first true molar, so that it is impossible to say whether or not there was more than one true molar in the lower jaw. The resulting dental formula would be as follows:

$J. \frac{3}{2}, C. \frac{1}{1}, PM. \frac{4}{4}, M. \frac{1}{1}.$

MEASUREMENTS FOR LOWER JAW

	Inches
1. Depth of lower jaw at posterior border of the first true molar,	2
2. Length of lower canine,	1 1-2
3. Anterior and posterior diameter of the canine,	5-8
4. Transverse diameter of canine,	5-8

5. Length of crown of second premolar, 1-2
6. Anterior posterior diameter of second premolar, 1-2
7. Length of premolar and molar series present, 3 1-2

In comparing *Desmatophoca oregonensis* with modern Pinnipeds, we find it possessing characteristics of each of the two families Otaridae and Phocidae, and as the Walrus family is considered only a specialized form of Otaridae we have not considered it separately.

The large size of the canines and outer incisors; square muzzle; shape of anterior nares; the uncerrated teeth and salient mastoid, are all features which remind one forcibly of Eumetopias among Sea Lions. But the shape of the nasals and their relations to the fontals; the very rudimentary postorbital processes; the articulation of the malar with the process of the temporal; the angle of the occipital with the extension of the palatal are characters more like Phoca. While some features as the teeth of the molar series and the development of the paroccipital are quite different from either.

The fact that *Desmatophoca* possesses so many characteristics of each of the now divergent modern types, seems to point toward a common ancestry rather than a separate origin for Otaridae and Phocidae.

In the study of ancient Carnivora we find the evolution of their dentition is often marked by a gain of some part of a tooth as a new heel, a new root or an extra cusp. Or if a tooth be lost it is usually connected with the progressive change in form and function of a neighboring tooth which tends toward greater complexity of dentition.

But among Pinnipeds the progress has been the reverse. They have been slowly losing a cusp here and a root there and with every loss they pass further away from complexity and nearer the extreme simplicity of the dentition of modern forms.

This general statement has a direct bearing on the relation of our fossil to the theories of the origin of Pinnipeds. But in considering the relationship of *Desmatophoca oregonensis* to the land Carnivora we can but touch in a most superficial manner upon what may become problems of extreme interest to the expert paleontologist.

Huxley and Mivart were of the opinion that seals were derived from the Bears. The great objection to this view is that Bears are of comparatively recent origin, having been derived from the dogline of ancestry by way of *Amphicyon* and its allies. Our fossil seal is as old or older than any bear known and the differences between *Desmatophoca* and the bear-like dogs of the Miocene are quite as great as between

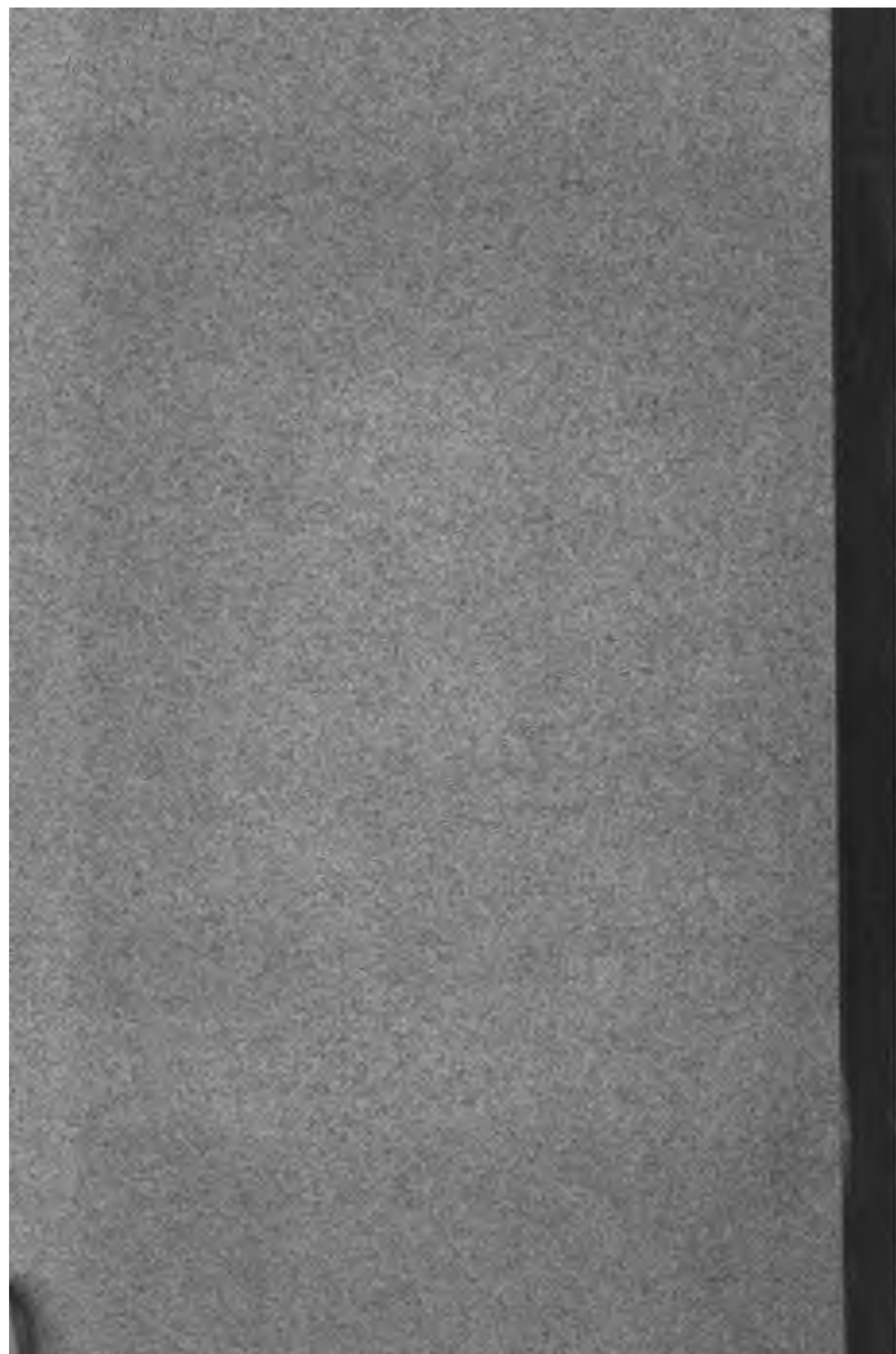
modern seals and bears.

It has been more recently suggested by Wortman that Pinnipeds may have been an offshoot from a Creodont ancestry.* "Perhaps from some as yet undiscovered member of the Oxyaenidae." Dr. Wortman has carefully examined *Desmatophoca oregonensis* and finds: the rapid reduction of the molars, the massiveness of the zygomatic arch, the relation of the paroccipital to the mastoid, especially the large size and backward projection of the former, the massive symphysis and great depth of the lower jaw, the great interorbital constriction, the general aspect of the skull and the structure of the fourth premolar, are all features characteristic of the Creodonts especially of *Patriofelis*. Dr. Wortman considers the strongest resemblances of the fossil are with modern seals and "wherever it departs from the modern Pinniped it approaches the Creodonts rather than *Fissipeds* or *Carnassidentia*." But he adds; "While there are certainly some strongly marked Creodont features it is yet far removed from any known member of that group."

In conclusion we may add that our fossil still further strongly suggests, if not confirms, the theory of the origin of Pinnipeds from the terrestrial Carnivora. But if we compare the Miocene Pinniped with the modern *Phoca* and *Otaria* and note the relation of the changes that have taken place to the lapse of time required to produce them; if we then turn our minds eye backward from that way station in the Miocene toward the hypothetical terrestrial ancestors, and mark the great differences that had been eliminated before the days of our fossil, we are impressed with the conviction that search must be made far back in the Eocene and perhaps even earlier before the first of Pinnipeds be found. And who can stand at this Miocene way station in the evolution of Pinnipeds and look first backward toward the ancestral stock, then forward down the intervening ages to the present forms, without feeling the grandeur of the slow, persistent, unceasing progress of creation.

*Osteology of *Patriofelis*, a Middle Eocene Creodont, Bull. Amer. Mus. Nat. Hist., May, 1894.





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